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On the way to Disaster Resilience

Role of AI in Disaster Mitigation

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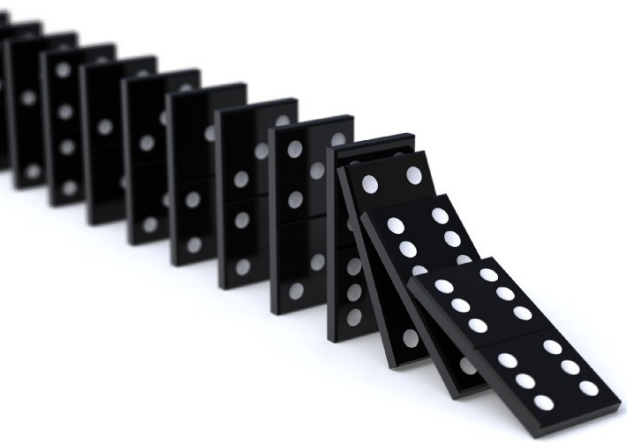

On 2nd July 2021, a town in British Columbia was burnt down due to a fast-moving wildfire following an intense heatwave. One of the survivors said, "I ran towards the town, and the fire was pretty much following me, and in about 15 minutes, the whole town was gone.". It is not the first time that disasters of this scale have occurred and wreaked havoc. Globally, on average natural disasters are the cause of more than 60,000 deaths every year. The Haiti earthquake in 2010 has killed more than 3,16,000 people and affected the lives of more than 3 million people. Being the poorest country in the Latin America and Caribbean region, Haiti did not have the capabilities to handle a disaster of this scale, and the country's GDP dropped by 8%.

Natural disasters result in catastrophic damage and substantial economic losses, especially for low to middle-income countries that are not equipped with the proper infrastructure to deal with them, and their recovery may even take decades. With increasing climate changes, the number of disasters and their damage is showing an increasing trend. In 2020, natural disasters threatened more than 160 million people, and global economic loss stood at US$268 billion.

It is the responsibility of disaster managers to develop new methodologies and utilize technology to mitigate these disasters. With the advent of Artificial Intelligence, we now can analyse voluminous data to extract valuable insights that can help in rapid response during all four phases of disaster management (Mitigation, Preparedness, Response, and Recovery). This article will discuss applications of AI models and their role in effectively supporting decision makers in the disaster mitigation phase.

Disaster mitigation includes identifying the hazards, predicting the impact, assessing the vulnerable areas, and developing strategies to make the community more

disaster resilient. For example, once a cyclone or hurricane is identified, Hazard Zone maps can be created using various data sources such as terrain conditions, weather, previous disaster data, and human activities in that region. These maps help in evacuation and relief operations and identify potentially hazardous sites such as chemical industries or waste storage locations. Identifying them is crucial to isolate or contain them to avoid the release of toxic chemicals, which could have otherwise hampered the rescue efforts.

Though traditional methods help identify hazards, as we have observed, they are prone to false alarms and are labour intensive and complex. With the help of AI models and their application in zone maps, we can identify high-risk regions. For instance, many researchers have used old disaster data (or simulated data) and applied logistic regression, support vector machine, and neural networks in problems such as snow avalanche prediction, landslide susceptibility, forest fire susceptibility, and other disasters with excellent performance. Let us look at few such research works.

In collaboration with Tohoku University and The University of Tokyo, Fujitsu used the power of the Fugaku supercomputer to generate 20,000 possible tsunami scenarios based on high-resolution simulations and used them as training data for building an AI model to predict flooding before landfall at high resolution. On a similar track, Google has also developed an AI platform that used the data collected from rainfall records and flood simulations to predict floods and warn users via Google Maps and Google search.

Scientists at Google and Harvard have built a neural network to predict the aftershocks of an earthquake by studying more than 131,000 earthquakes and aftershocks. On testing this model on 30k events, the neural network predicted the aftershock more precisely than the traditional models. Feyera Hirpa, Data Scientist of One Concern Inc., tested his prediction model during the 2019 Chikuma River flood in Japan caused by typhoon Hagibis. The flooding model was comparable to the actual flood & validated the power of prediction AI Models.

Satellite Image Analysis can play a critical role in mitigating the impact of the disaster. In Australia, Researchers at Monash Data Futures Institute have used the Sentinel-2 Satellite image data to analyse 4300+ high-resolution images to generate a vegetation map of Victoria state. They built a model using time series classification that could annotate moisture and atmospheric temperature data to understand the vegetation better and its purpose of usage. These hazard maps can also play a crucial role in bushfire prevention, agricultural planning, pollution management, and rehabilitation efforts.

Few other AI research areas during the disaster mitigation phase include identifying community influencers to calm the people during the event, estimating the needs of people, applying optimization algorithms for best plans, and comparing different mitigation strategies.

To summarize, Proper disaster mitigation plans made with the collaboration of physics and AI models help achieve a high level of preparedness and disaster resilience. These insights enable authorities to proactively plan related to evacuation in high -risk identified zones, rehabilitation centres selection, transportation routes, warehouses (to store the aid resources), and distribution routes. These actions help to save many lives, reduce property damage, and implement successful recovery operations.